

**Armed Forces  
Radiobiology Research Institute**



**Mission and Capabilities**

**COL Robert Eng**

**Armed Forces Epidemiology  
Board**

**18 September 2001**



# Facts

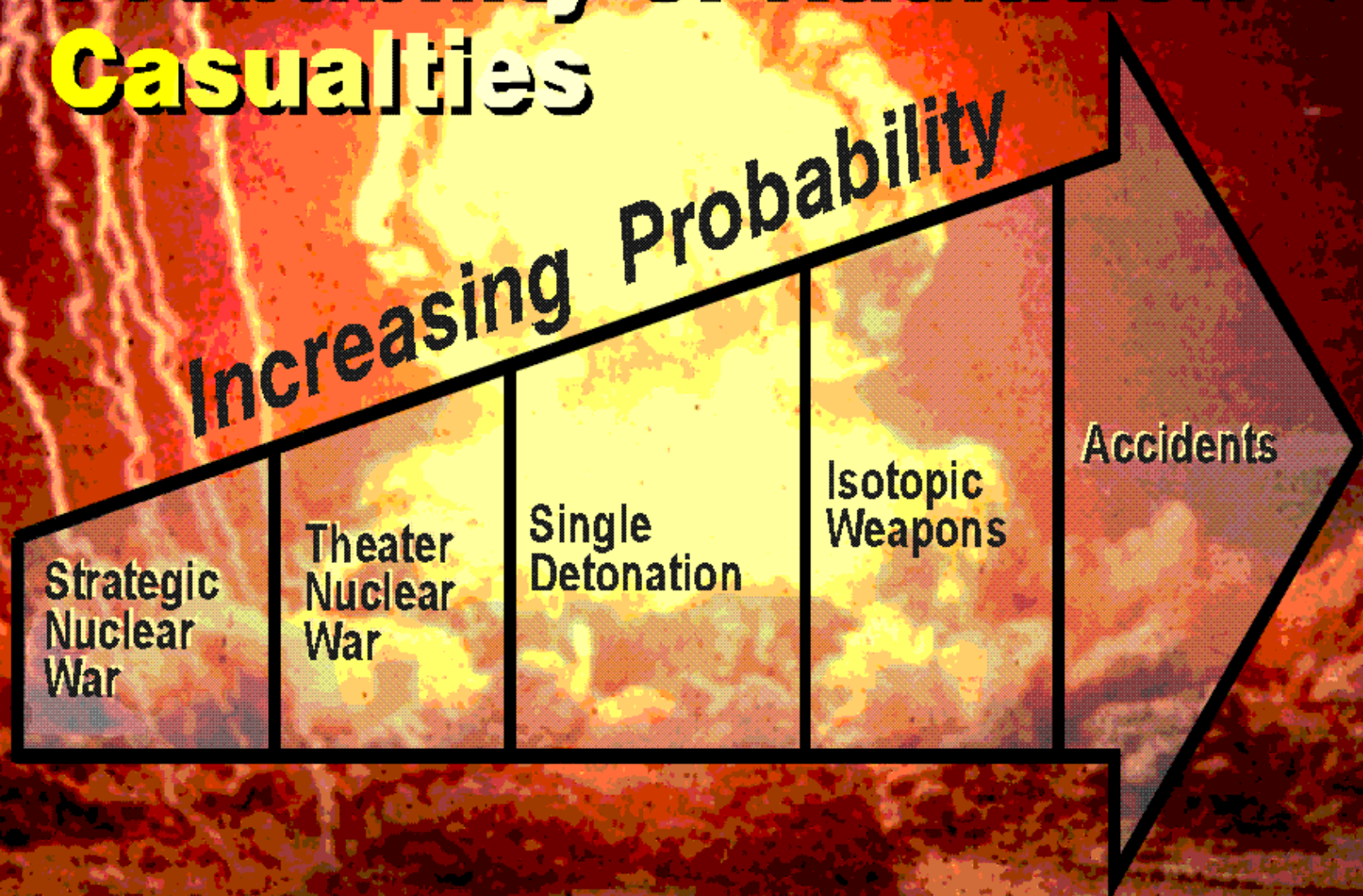
- **There are effective drugs to address radiation-induced hematologic suppression.**
- **There is insufficient information from cancer therapy to form comprehensive doctrine on treatment of radiation-induced sepsis (via the gut).**



# Briefing Outline

- **Threat**
- **Mission**
- **Organization**
- **Research Programs**
- **Operational Support**
- **Conclusion**

# Probability of Radiation Casualties



# World Trade Center





# Nuclear/Rad Threat

- **Radiological Dispersal Devices**
- **Terroristic Placement of Radiation Sources**
- **Destruction of Nuclear Reactors in the Area of Operations**
- **Use of Nuclear Weapons**



# AFRRI Mission

- **Conduct radiobiology research and develop medical countermeasures for DoD (Prevent, Assess, Treat).**
- **Train medical personnel on the medical effects of ionizing radiation.**
- **Advise JCS (J-4 Medical), OSD (Nuclear Matters), CINCs, and others on**



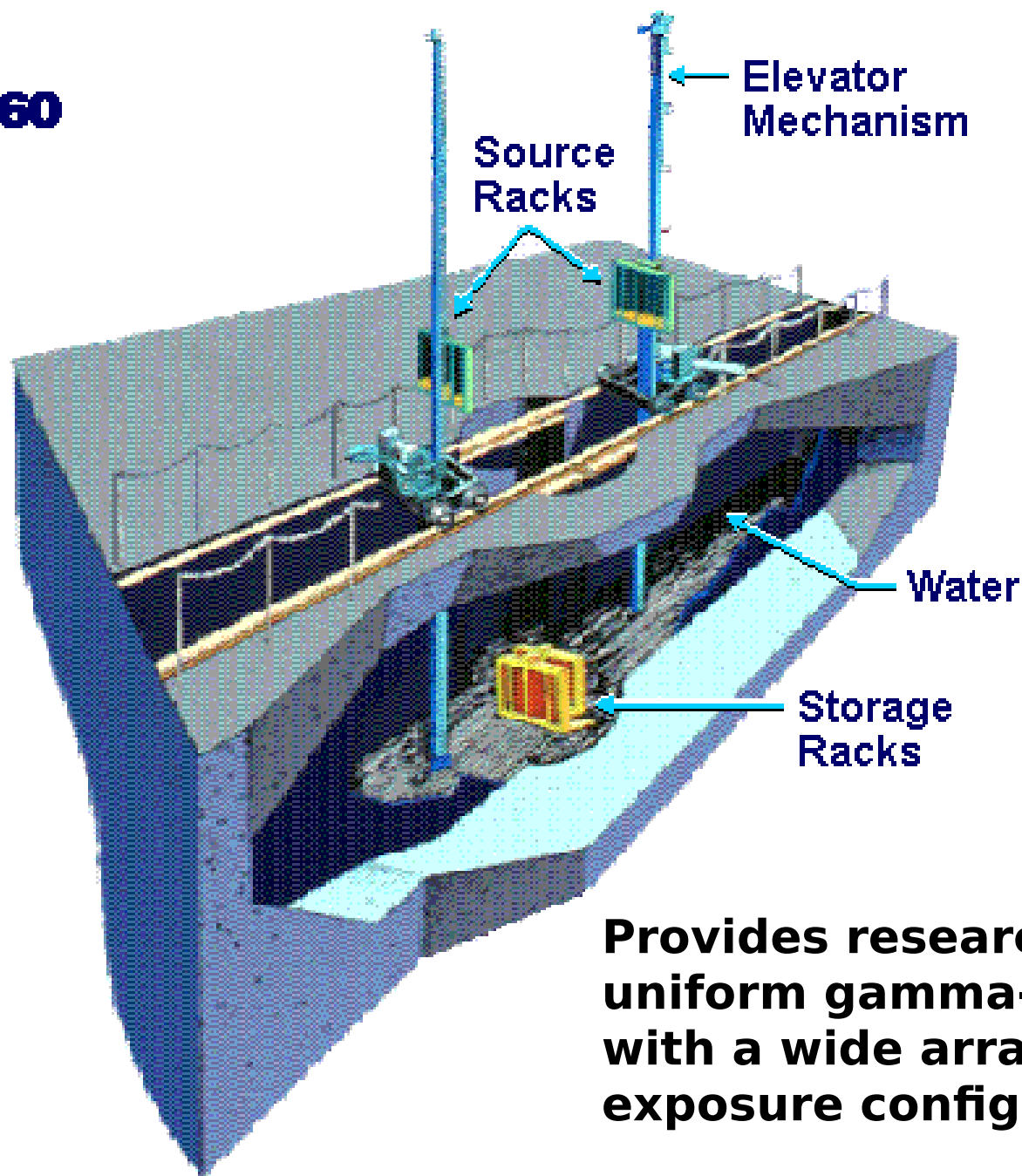
# Radiation Sources



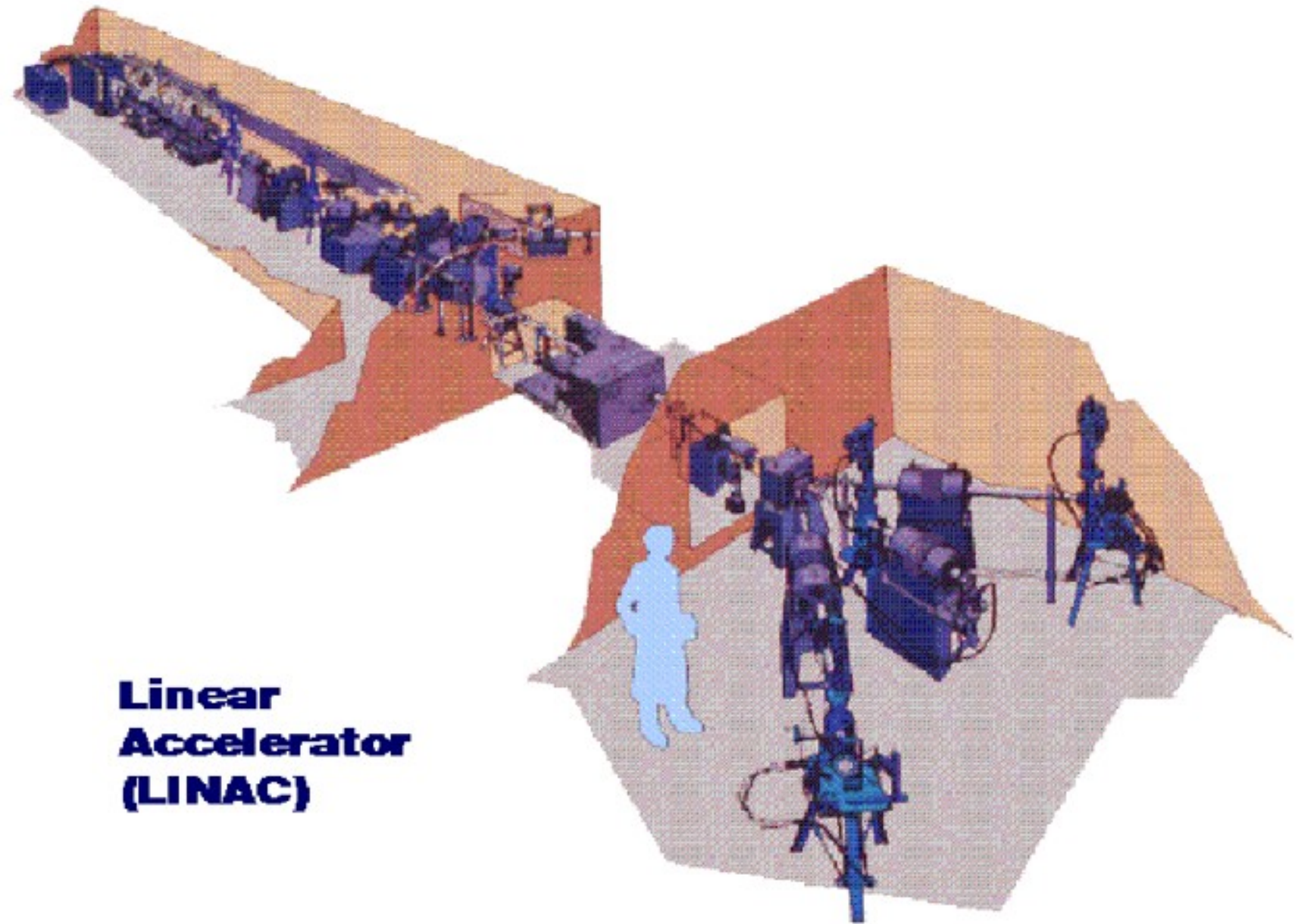
Runs at pulses of 2,500 megawatts steady rate of 1 m

**Runs at pulses of up to 2,500 megawatts and at a steady rate of 1 megawatt**

## **Cobalt-60 Source**



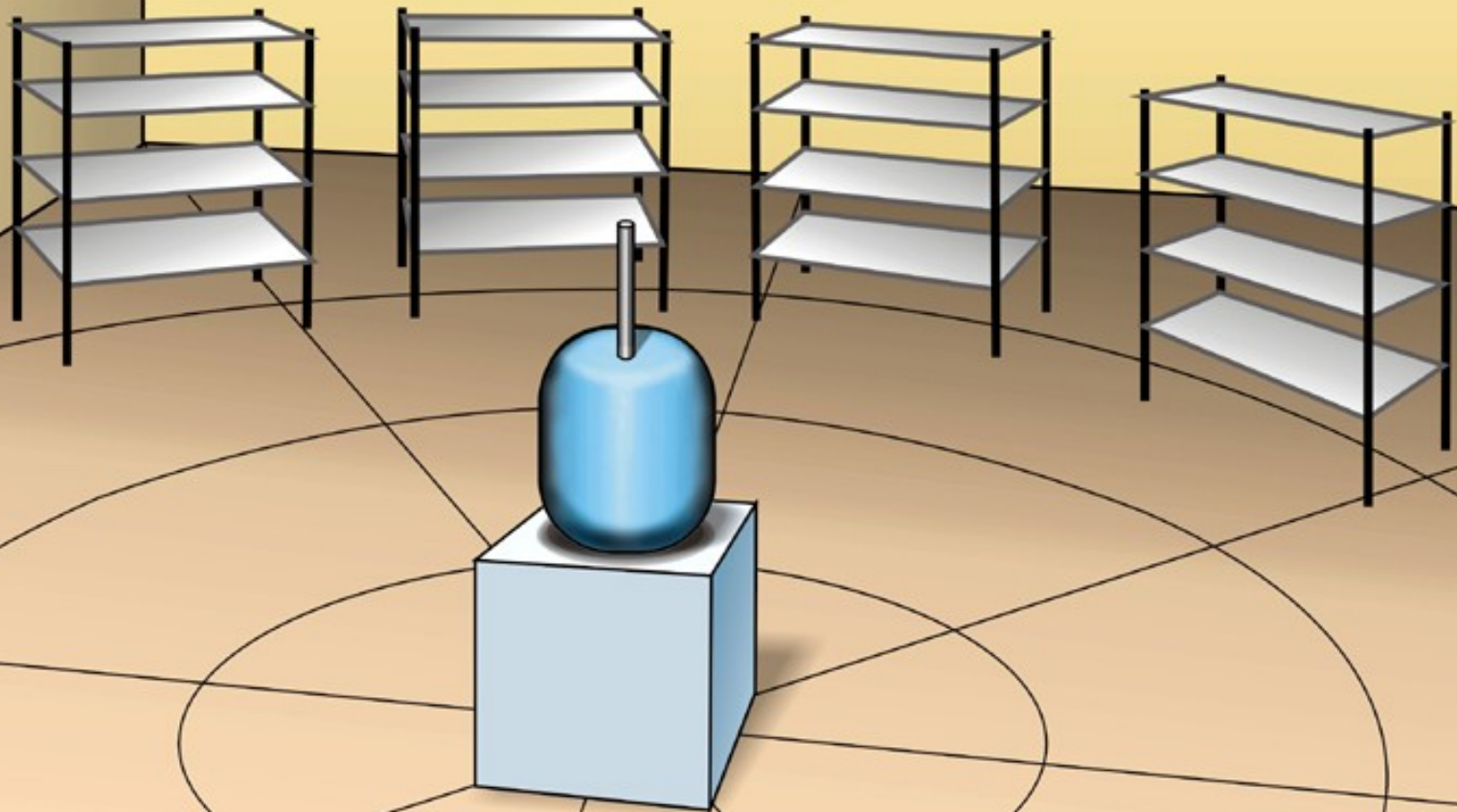
**Provides researchers large uniform gamma-ray fields with a wide array of exposure configurations**



## **Linear Accelerator (LINAC)**

**Generates high-energy electrons (up to 54 MeV)  
and x rays**

# **Low-Level Radiation (LLR) Exposure Facility**



**Delivers chronic radiation doses to  
biological**



# **Veterinary Sciences Department**

- **Nationally accredited animal care and use facility and program**
- **Animal facility designed to support radiation and surgery studies**
- **Currently supporting AFRRI, FDA, Navy, WRAMC, and USUHS studies**



# Research Teams

- **Radiation Casualty Management**
- **Biological Dosimetry**
- **Nuclear/Biological/Chemical Interactions and Countermeasures**
- **Health Effects of Embedded Depleted Uranium**



# Radiation Casualty Management

**Dr. Tom Seed**

**Objective: Develop medical strategies to reduce the number and severity of radiation-induced casualties (pretreatment/treatment).**



# Approach to Problem P&T Strategies

**Prophylaxis**

Pre-exposure  
Period

Exposure  
Period

**Therapeutics**

Postexposure  
Period

**Benefits**

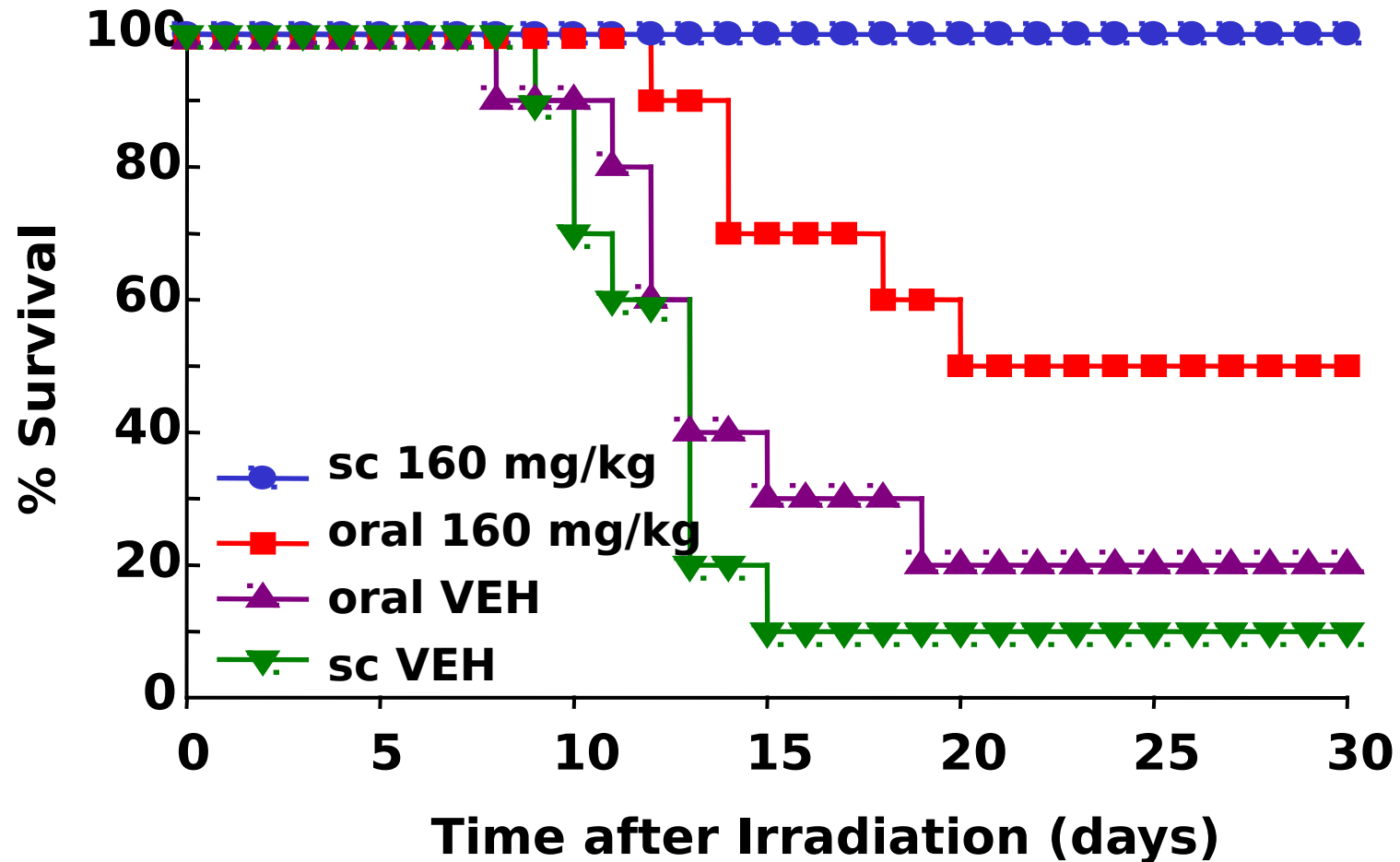
**Benefits**

- Improved blood-forming capacity
- Reduced infections
- Increased wound healing
- Performance sustainment
- Higher mission success rate
- Reduced late effects



# Radioprotective Steroid 5-Androstenediol

5-AED 1 d before 10.5 Gy: sc vs. oral





# Biological Dosimetry

**Dr. Bill Blakely**

**Objective:** Develop fieldable and automated biological dosimetry capability for radiation dose assessment on the battlefield (triage/unit health status).



# Biological Dosimetry

- **Problem = Not every service member has a physical dosimeter.**
- **Backup Solution = Draw blood from casualties to quickly estimate radiation dose in the field setting or at AFRRI.**
- **AFRRI is the only DoD lab with such capabilities.**

# Symmetric Battlefield

## ECHELON I

- Hand-held Devices
- Biodosimetry Software



Casualty



Battalion Aid Station  
Physician/PA

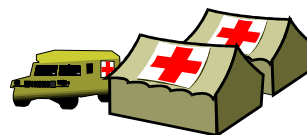


## ECHELON II

- Hand-held Devices
- Biodosimetry Software

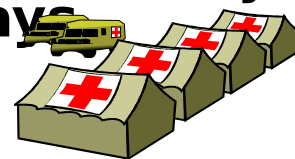


Forward Surgical Team



## ECHELON III

- Hand-held Devices
- Biodosimetry Software
- Biodosimetry Assays



TAML  
(Theater Area  
Medical  
Laboratory)

Corps Hospitals



Advanced Medical Hospitals





# NBC Interactions and Countermeasures

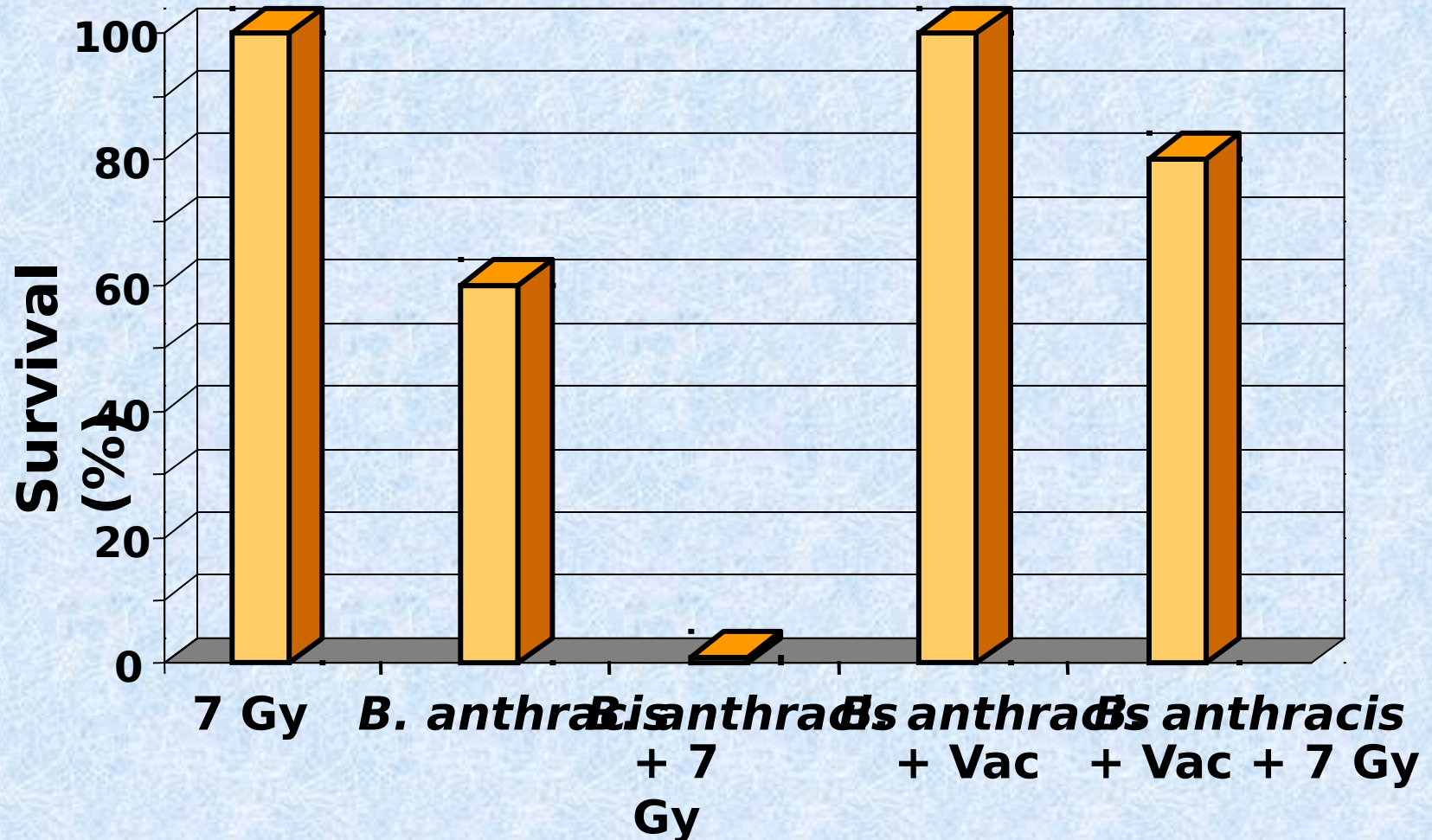
**Dr. Greg Knudson**

## **Objectives**

- **Health effects**
  - **Combined radiation/anthrax effects**
  - **Radiation-induced translocation of enteric organism causing sepsis**
  - **Assessment of therapeutic strategies**
- **Casualty prediction models**

# Anthrax Vaccine Efficacy in Mice

Sublethal Irradiation (7 Gy) and Intratracheal Spore Challenge ( $4 \times 10^8$  *B. anthracis* Sterne Spores)



# Mixed Infection after Combined Injury: γ Irradiation and Intratracheal Challenge with *Bacillus anthracis* Sterne Spores

Bacteria Isolated from Lung, Spleen, and Blood of Mice

γ Radiation: 0, 3, 5, 7 Gy  
*B. anthracis* Spore  
Challenge: 0

[None]

SYNERG

Y

γ Radiation: 0 Gy  
*B. anthracis* Spore  
Challenge:  $4 \times 10^8$   
*B. anthracis*

γ Radiation: 3, 5, 7 Gy  
*B. anthracis* Spore  
Challenge:  $4 \times 10^8$

*B. anthracis*  
*Enterococcus faecalis*  
*Erysipelothrix* sp.  
*Staphylococcus* sp.  
*Enterobacter cloacae*  
*Klebsiella pneumoniae*  
*Acinetobacter lwoffii*  
*Escherichia coli*



# Health Effects of Embedded Depleted Uranium

**Dr. Dave McClain**

**Objective: Determine early and late effects of depleted uranium (DU) shrapnel to develop treatment strategies.**



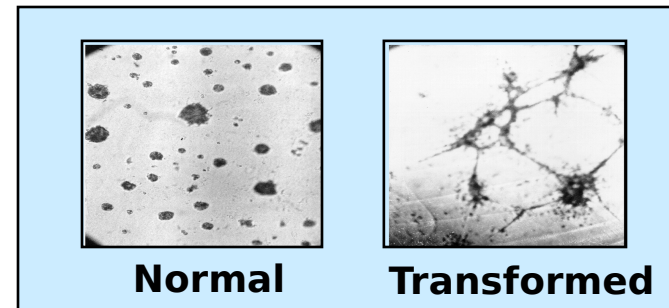


# Health Effects of Embedded Depleted Uranium

- **Problem = There were 30+ DU casualties from the Gulf War. Potential toxic effects have not been well characterized.**
- **Solution = Characterize the potential carcinogenic and other effects through research; being done.**
- **AFRRI is the only DoD lab engaged in such research and is**

# Comparison of Transformation Rate and Tumorigenicity of Militarily Relevant Heavy Metals

**DU Transforms Cultured Cells to Tumorigenic Phenotype**



**Normal and DU-Transformed HOS Cells**

	Untreated	Tungsten	Nickel/Cobalt	Nickel	Lead	Soluble DU	Insoluble DU	DU/Phenyl Acetate
<b>Transformation rate*</b>	0/2	28.2	121.5	29.9	21.1	40.2	115.9	4.7
<b>Tumorigenicity**</b>	0/82	8/24	10/12	7/24	2/20	11/25	13/20	0/12

Number of transformed cells per 500,000 surviving cells

\*\*Number of tumors formed when 1 million transformed cells were injected into immune-compromised mice



# **Operational Support Activities**



# Medical Effects of Ionizing Radiation Course

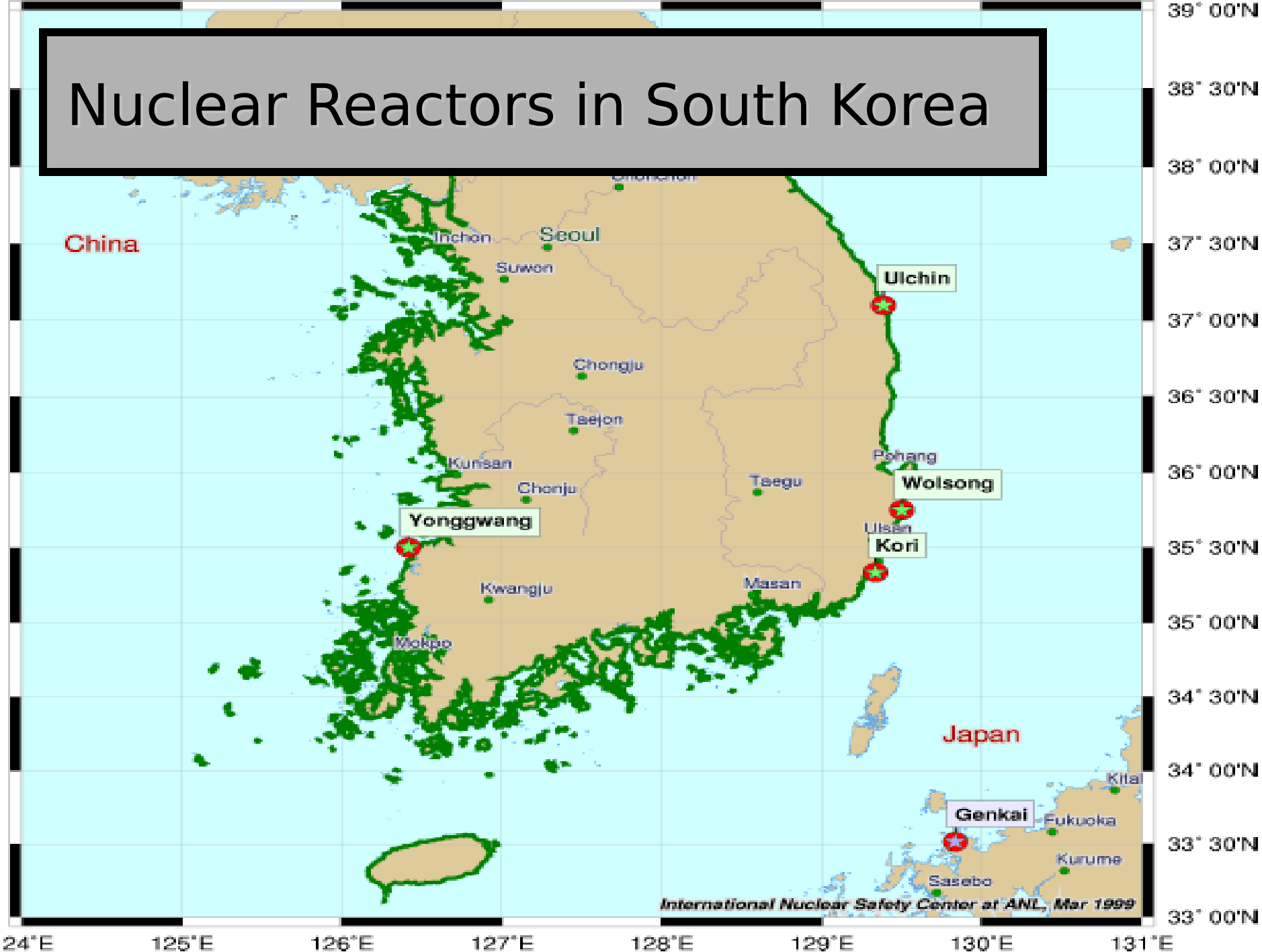
**Objective: Provide training to all DoD medical personnel on the management and treatment of radiation casualties.**



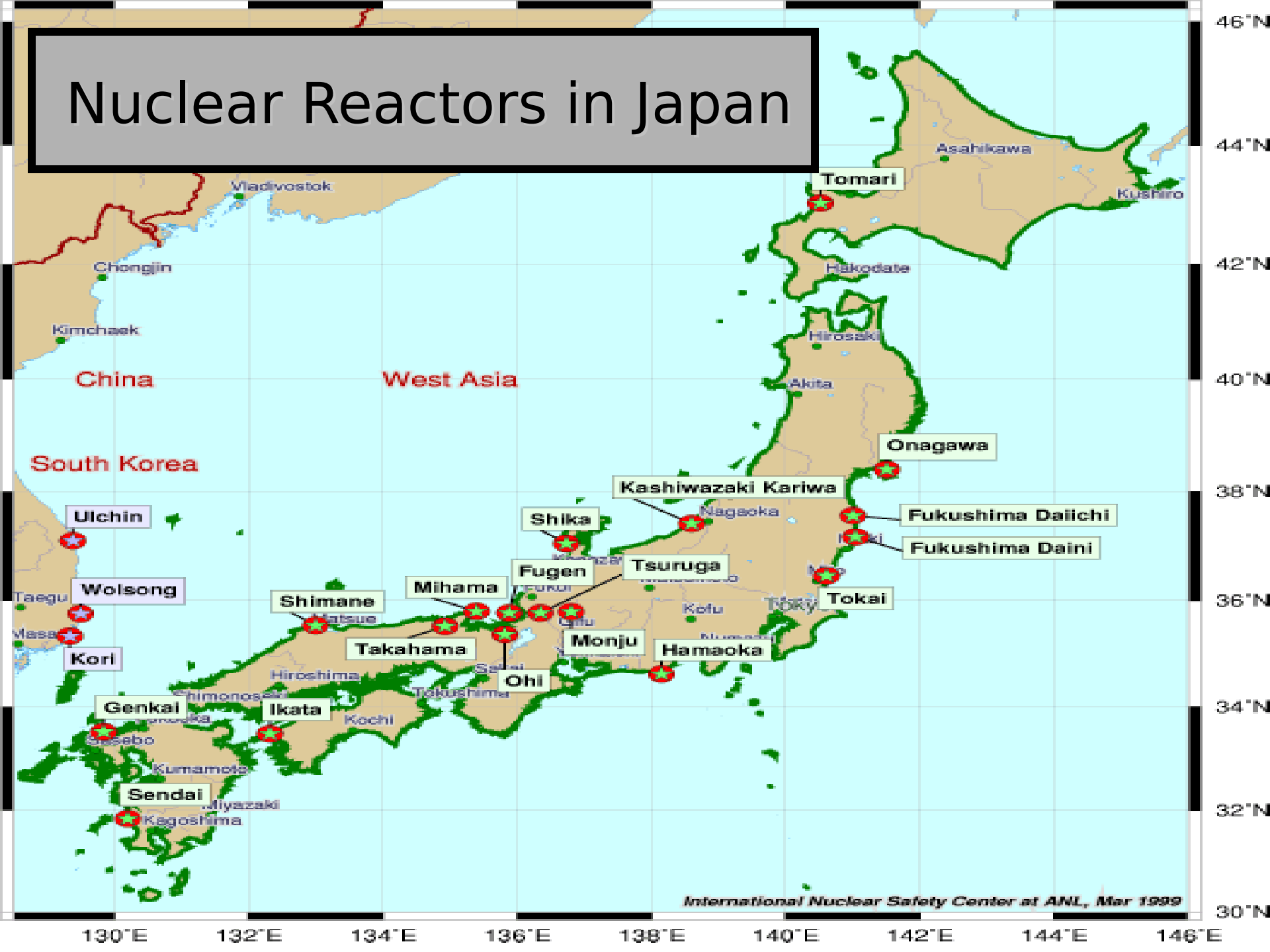
# Medical Radiobiology Advisory Team (MRAT)

- **Member of Consequence Management Advisory Team**
- **On-site medical radiobiology and health physics advice**
- **Liaison to treatment centers**
- **Plume prediction modeling**
- **Site restoration cost analysis**
- **Radiological biodosimetry bioassay**

# Nuclear Reactors in South Korea



# Nuclear Reactors in Japan





# Conclusion

**Medical nuclear/radiological  
readiness is **now**, not later.**

